REMARKS

The Office Action of July 14, 2004 has been received and its contents carefully considered.

Claims 1, 8 to 10, 12 to 17 and 19 to 21 are all the claims pending in the application, prior to the present amendment.

The Examiner has attached to the Office Action an Interview Summary of the telephone conference of July 12, 2004. In the Interview Summary, the Examiner states that one of ordinary skill in the art would readily possess the knowledge that an in-plane magnetization is either circumferential or radial, and that mixed directions, while possible, would actually read on both magnetization directions since a component of the magnetization would be both in the radial and the circumferential directions. The Examiner states in the Interview Summary that a new Office Action will be mailed, in which the Shukh et al reference would be applied based on the implicit teaching of circumferential and radial.

In the present Office Action, the Examiner does not reject the claims based on the Examiner's belief that the in-plane magnetization in Shukh et al implicitly teaches circumferential and radial directions. Instead, the present Office Action relies on the combination of Shukh et al with the newly applied Akiyama et al patent to arrive at the combination at the present claims.

Applicants discuss below the various rejections that the Examiner sets forth in the Office Action. In addition, applicants incorporate the substance of a second telephone interview with

Applicants have amended independent claims 16 and 20 in a similar manner, and have added new dependent claims 22 to 25 in order to specify the range of the thickness of the orientation control layer and the material of the orientation control layer.

Shukh et al (USPA 2002/0028357A1) disclose the existence of magnetic directions of soft magnetic layers in Fig. 3. However, the Shukh et al patent specification does not specify the magnetic directions. Therefore, in the Shukh et al invention, it cannot be understood from the arrows in Fig. 3 that the magnetic directions of the soft magnetic layers (48, 50, 52 and 54) are along the radius of a substrate (38, Fig. 2) and are oriented towards the periphery of the substrate or towards the center of the substrate.

The Examiner recognizes that Shukh et al do not disclose the recitation that the direction of the magnetization of the soft magnetic layer is along the radius of the non-magnetic substrate and is oriented towards the periphery of the substrate or towards the center of the non-magnetic substrate. The Examiner states that Shukh et al disclose that the invention is in the form a magnetic disc and that the magnetization directions are in the plane of the substrate.

The Examiner cites the Akiyama et al patent as disclosing a perpendicular recording medium comprising a soft magnetic layer, wherein the magnetization direction is controlled to be in the radial direction in order to suppress the generation of domain walls and Barkhausen noise, as well as insuring high reproducing efficiency. The Examiner particularly refers in the Office Action to Figure 15 of Akiyama et al, the discussion at column 3, lines 16 to 34, and the discussion at column 4, line 55 to column 5, line 12.

the Examiner on December 7, 2004, which the Examiner summarizes in an Interview Summary sent on December 21, 2004.

Claims 1, 3, 4, 8, 10, 12, 14, 16 and 20 have been rejected under 35 U.S.C. § 103(a) as obvious over Shukh et al in view of Akiyama et al.

Applicants submit that Shukh et al and Akiyama et al et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

The present invention, as set forth in claim 1, relates to a magnetic recording medium comprising, in sequence, on a nonmagnetic substrate, at least one soft magnetic underlayer, an orientation control layer to control the orientation of the layer immediately above, and a perpendicular magnetic layer having an axis of easy magnetization which is oriented mainly perpendicularly to the nonmagnetic substrate. The soft magnetic underlayer has a multilayer structure consisting of a plurality of soft magnetic layers comprising a soft magnetic material, and one or more separation layers interposed between the soft magnetic layers, and at least one of the soft magnetic layers comprises a material with a structure having no magnetic domain walls. The direction of magnetization of an upper soft magnetic layer is different from the direction of magnetization of a lower soft magnetic layer, and the direction of the magnetization of the soft magnetic layer is along the radius of said nonmagnetic substrate and is oriented towards the periphery of the substrate or towards the center of the nonmagnetic substrate.

Thus, applicants have amended claim 1 to state that the soft magnetic underlayer consists of the plurality of soft magnetic layers and one or more separation layers.

The Examiner argues that it would have been obvious to modify the device of Shukh et al to use a soft magnetic layer having a direction of magnetization along the radius of the non-magnetic substrate in view of the teachings of Akiyama et al, since such magnetization directions suppress the generation of domain walls and Barkhausen noise, as well as insuring high reproducing efficiencies.

At the interview of December 7, 2004, applicants argued against Figure 15 of Akiyama et al, as well as against Figures 16 and 17 of Akiyama et al as follows.

In Akiyama et al, Figs. 15 to 17 disclose constitutions that apply a magnetic field perpendicular to the magnetization direction of multiple layers. However, these constitutions all differ from Shukh et al, in terms of the method of achievement.

In particular, Fig. 15 of Akiyama et al shows a constitution that applies a magnetic field perpendicular to the magnetization direction of the soft magnetic layer by providing high coercive force films 28a and 28b on both sides of the high-permeability (soft) magnetic layers 22 and 22'. On the other hand, Shukh et al in Fig. 3 shows that a perpendicular magnetic recording medium with antiferromagnetic coupling in a soft magnetic layer is formed by providing a non-magnetic coupling layer 56 between the interface layers 50 and 54. See paragraphs [0025] and [0021].

Fig. 16 of Akiyama et al shows that by magnetostatically coupling high-permeability magnetic layer 22 and high coercive force film 28, the constitution applies a perpendicular magnetic field to both layers. See column 13, lines 30 to 37. However, the high coercive force

film 28 is not a soft magnetic film, and differs from the constitution of Shukh et al that applies a perpendicular magnetic field to a plurality of soft magnetic layers.

Fig. 17 of Akiyama et al, similarly to Fig. 15, discloses a constitution that applies a magnetic field perpendicular to the magnetization direction of a soft magnetic layer by providing permanent magnets 21a and 21b on both sides of a plurality of high-permeability (soft) magnetic layers 22. See column 13, lines 39 to 49. However, the method differs from the constitution of Shukh et al as described above.

In light of the above, in contrast to the constitution of Shukh et al that employs antiferromagnetic coupling, the constitution of Akiyama et al is achieved using high coercive force film and permanent magnets, so that both constitutions differ significantly.

In other words, even though Akiyama et al disclose making the magnetization direction of a soft magnetic layer the radial direction, since the methods of applying magnetic fields differ significantly in both constitutions, there is no motivation to apply this to Shukh et al.

The Examiner appeared to agree during the interview of December 7, 2004 that in view of applicants' comments with respect to Figures 16 and 17 of Akiyama et al, that these Figures did not provide a basis for a combination of Shukh et al with Akiyama et al.

The Examiner, however, did not agree that the teachings of Figure 15 of Akiyama et al could not be combined with Shukh et al, especially in view of the additional teachings of Figures 3 and 11 of Akiyama et al.

With respect to Figure 15 of Akiyama et al, the Examiner took the position that the present claims do not exclude the high coercive films 28a and 28b of Figure 15.

Further, the Examiner appeared to be taking the position that it would have been obvious to employ the carbon interlayer 24 of Figure 3 of Akiyama et al between the perpendicular magnetic layer 23 and the high permeability layer 22 of Figure 15, to thereby arrive at the present invention.

In response, applicants point out that the description of Figure 3 of Akiyama et al does not discuss a radial direction. Further, Akiyama et al disclose that an interlayer such as carbon interlayer 24 of Fig. 3 generates spacing loss and is not desirable. See, for example, column 5, lines 13 to 31.

In all of the embodiments of Akiyama et al beginning with Figure 5, there is no carbon underlayer. See, for example, column 10, lines 19 to 24 and column 12, lines 20 to 27 where Akiyama et al further discuss the absence of an interlayer. The embodiments beginning with Figure 5 are embodiments that set forth the detailed structure of the perpendicular recording medium according to Akiyama et al, as disclosed at column 9, lines 5 to 56. In contrast, the embodiments of Figures 1 to 4 of Akiyama et al including Figure 3, are embodiments in which Akiyama et al describe a first aspect of their invention that relates magnetic heads. This first aspect is described at column 3, line 16 to column 4, line 30 and at column 6, line 45 to column 9, line 49 and emanates from the Akiyama et al Japanese Priority Application 4-226582, filed on August 26, 1992 which was published as JP-A-6-76202. A copy of JP-A-6-76202 is enclosed,

together with a copy of an English-language Patent Abstracts of Japan thereof and an English language computer translation thereof. The second aspect of the disclosure of Akiyama et al described at column 4, line 31 to column 5, line 32, and including Figures 5 to 17, which are described at column 9, line 57 to column 13, line 48, in which no carbon interlayer is employed and which specifically teaches against the use of such a carbon interlayer, emanates from the Akiyama et al Japanese Priority Application 4-184254, filed on July 13, 1992, and published as JP-A-6-28652. A copy of JP-A-6-28652 is enclosed herewith, together with a copy of an English-language Patent Abstracts of Japan thereof and a copy of an English language computer translation thereof.

Since Akiyama et al specifically teach against the use of interlayers in the embodiments of Figures 5 to 16, applicants submit that one of ordinary skill in the art would not be led to combining the teachings of Fig. 15 and Fig. 3 of Akiyama et al and would not have any motivation to do so. It would be hindsight to do so.

In further response to the Examiner's reliance on Figure 15 of Akiyama et al and his position that the present claims do not exclude the high coercive films 28a and 28b shown in Figure 15 of Akiyama et al, applicants have amended claims 1, 16 and 20 to recite that the "soft magnetic underlayer has a multilayer structure consisting of a plurality of soft magnetic layers comprising a soft magnetic material, and one or more separation layers interposed between the soft magnetic layers". Thus, the present claims exclude the high coercive films 28a and 28b of

Figure 15 of Akiyama et al, as well as the permanent magnets 21a and 21b of Figure 17 of Akiyama et al.

Akiyama et al do not disclose forming a soft magnetic underlayer from only a plurality of soft magnetic layers and separation layers.

At the interview of December 7, 2004, applicants discussed with the Examiner a number of further amendments that the Examiner might be willing to accept to distinguish over the combination of Akiyama et al and Shukh et al.

First, Shukh et al, at page 3, left hand column, lines 3 and 4, disclose that the spacer layer 42 (in a position corresponding to the orientation control layer of the present claims) may have a thickness of 5 to about 50 angstroms, corresponding to .5 to 5 nm. Therefore, in Shukh et al, the spacer layer 42, corresponding to the orientation control layer of the present claims, is desired to be made very thin.

In the present invention, the orientation control layer, as disclosed at page 12, has a thickness of 50 nm or less, and as disclosed in Example 1, at page 27, next to last line, can have a thickness of 8 nm. The Examiner stated that applicants, therefore, could claim a thickness of 8 nm to 50 nm for the orientation control layer, which would distinguish from Shukh et al.

The Examiner recognized that Akiyama et al disclose that the carbon interlayer 4 has a thickness of 0.04 μm, which corresponds to 40 nm. The Examiner stated, however, that since Shukh et al disclose a thickness of .5 to 5 nm which is thin, one of ordinary skill in the art would not be led to combining the teachings of the thin thickness of .5 nm to 5 nm of Shukh et al with

the 40 nm thickness of the orientation control layer 24 of Akiyama et al. Therefore, claims directed to a thickness of 8 to 50 nm would distinguish over the references. New claims 22 and 24 are such claims.

Applicants undersigned attorney also discussed with the Examiner amending the claims to distinguish over the combination of Shukh et al and Akiyama et al by reciting specific materials for the orientation control layer.

Thus, Shukh et al disclose at page 3, left hand column, that the spacer layer 42 can be made from Cr, Ti, Ta and TiO_2, and Akiyama et al disclose in Figure 3 a carbon interlayer layer 24.

The present application layer, at page 11, last two paragraphs, discloses a large number of possible materials for the orientation control layer. New dependent claims 23 and 25 exclude Ti, C, Cr, O and NiTi from the materials disclosed at page 11, and recite the remaining materials. Applicants submit that new claims 23 and 25 provide a further basis for patentability over the combination of Shukh et al and Akiyama et al.

In addition, at the interview of December 7, 2004, the Examiner appeared to be taking the position that in view of the teachings of Figure 11 of Akiyama et al, although it was not necessary in Figure 11 to employ an interlayer between the soft magnetic layer and perpendicular magnetic layer to arrive at a radial direction of the magnetization of the soft magnetic layer, such an interlayer could readily be employed.

Further, the Examiner appeared to take the position that it would have been obvious that the soft magnetic layer in Fig. 11 could be replaced by a multilayer structure comprised of two soft magnetic layers and separation layer between the two soft layers.

Figure 11 of Akiyama et al shows a single soft material layer where a radial magnetization is produced by perpendicular magnetization regions 40a and 40b of the perpendicular magnetization layer. See the description at column 11, line 4 to column 12, line 27.

Applicants submit that the Examiner's position is based on hindsight. There is no suggestion that the teachings of Figure 11 can be applied to a soft magnetic underlayer that has a multilayer structure, or that the perpendicular magnetization regions 40a and 40b could be effective in a multilayer structure having two soft magnetic layers and a separation layer.

Further, Akiyama et al specifically disclose at column 12, lines 20 to 27 that in Figure 11 no interlayer is present between the soft magnetic layer 22 and the perpendicular magnetization layer 23, and therefore there is no interlayer originated spacing loss, and as a result high recording and reproducing efficiencies and high resolution are accomplished. Applicants submit that the only motivation to add such an interlayer layer would be based on the teachings of the present invention. This is hindsight.

Further, the Examiner appeared to be saying at the interview of December 7, 2004 that in view of the many different ways in Akiyama et al at arriving at a radial direction, that it would have been obvious to provide a radial direction of magnetization in the soft magnetic layer of

Shukh et al, and that a variety of means could be employed to achieve such a radial magnetization.

As discussed above, the methods for making the magnetization directions of the plurality of soft magnetic layers to be in opposite directions differ greatly. Applicants submit that there is no motivation to make the combinations that the Examiner appears to contemplate. The only motivation to make the combinations that the Examiner appears to contemplate come from the teachings of the present application, and it would be hindsight to do so.

In view of the above, applicants submit that Shukh et al and Akiyama et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

Claims 2, 5 to 7, 13, 15, 17, 19 and 21 have been rejected under 35 U.S.C. § 103(a) as obvious over Shukh et al in view of Akiyama et al and further in view of Tang et al.

Each of these claims depend ultimately from one of claims 1, 16 and 20. Accordingly, applicants submit that these claims are patentable for the same reasons as discussed above in connection with the rejection of claims 1, 16 and 20 over Shukh et al and Akiyama et al.

In view of the above, applicants submit that Shukh et al, Akiyama et al and Tang et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the

Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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Respectfully submitted,

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